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of universal law. When he arises to this conception, then, and not till then does he fully realize the necessity of obeying the laws of God and man. There are those and their name is legion, who really think that it doesn't matter very much whether we do right or wrong. They observe that evil sometimes goes unpunished, that the apparently good are not always happy. Such persons lose, or never gain, a proper respect for law either civil or moral. They are non-ethical chiefly because they have never risen to the conception of the universal reign of law. This conception need not, it does not, destroy feeling, it is complementary to it. It is not external to culture, a mere corrective, though it does correct. It is, or ought to be, a part of culture. This completeness of result, many of us believe, can be best secured by giving a fair proportion of time in secondary schools to experimental science.

C. C. WILSON

JERSEY CITY, N. J.

DISCUSSION

PROFESSOR E. G. CONKLIN, University of Pennsylvania: With most of the positions taken by those who have immediately preceded me I entirely agree. There are, however, some propositions with which I would take issue and still others which seem to me to demand even greater emphasis than has been given them.

In his fourth thesis Professor Tarr points out a truth which at this time needs to be presented frequently and earnestly. The colleges with relatively few exceptions do not properly recognize the science work done in the preparatory schools. Even in some of our largest universities there are no entrance requirements in science, and in a great number of higher institutions of learning these requirements are ridiculously small. The present attitude of all such institutions is one of positive discouragement to scientific teaching in the schools. There is, of course, a great deal of so-called science work in the schools which cannot be recognized by the colleges; but anyone who will take the pains to acquaint himself with the science work which is being done by the larger high schools, especially in the East and middle West, will be ready to testify that such work is worthy of being

recognized by the colleges. In fact it seems to me that there is a dangerous tendency on the part of such schools to offer work of too high, rather than of too low grade. On the other hand there is a great deal of poor and inadequate science teaching in some of the schools; this is pretty largely confined to the private preparatory schools and to the high schools of the smaller cities and towns. The excellent courses in science offered by the larger high schools are in no sense the result of the fostering influence of the higher institutions of learning; they are due to the fact that such schools have cut free from the colleges and are offering courses which meet the demands of their patrons. On the other hand the colleges are directly responsible for the deficiencies in the science work of the preparatory schools. A few of the leading universities of the country have taken some very practical steps to right this wrong (for I consider any system of education which neglects science as intellectually and morally wrong) and it is only a question of time when all our higher educational institutions will do likewise. As science teachers in the schools and colleges we should demand without ceasing that, in the entrance requirements, science shall be granted all the rights and privileges of the most favored subject. If three years of science work cannot be added outright to the entrance requirements, I should endorse the suggestion made by Professor Wilson that certain well-taught sciences be taken in lieu of other required subjects for admission to college.

In his fifth thesis Professor Tarr states that there is still much pseudo-science taught and that no claim can be made in its behalf. The same thing could doubtless be said of any other general subject. However, even pseudo-science, *i. e.*, science which is imperfectly taught, is better than no science at all. Apart from the method of science, its matter is of such value that it seems to me worth while to teach it in a poor and imperfect way, rather than to omit it altogether. I maintain that even text-book science is better than none, and while I should be opposed to accepting such work for admission to college, I feel that there should be no attempt to "eliminate" such work except by the process of substituting something better.

Another subject to which I wish to call attention is presented in Professor Tarr's theses Nos. 9 and 10. Whatever the consensus of opinion may be, it seems to me that the purely observational sciences ought in every case to precede the experimental. For that reason natural history is one of the very best subjects with which to begin.

Physical geography, if made really observational, is equally valuable. There has been of late a growing tendency to regard natural history as a sort of amusement, rather than as a serious and dignified study. The fact that experiment is one of the most important methods of science has apparently led some persons to the view that all science teaching should begin with experiment. However, science is no less observational than experimental, and it is observation rather than experiment which earliest appeals to the developing intellect. I have found no subject quite so interesting to children as natural history, and in the hands of competent instructors I believe none would be more useful. As things now are, young persons are introduced to science through the medium of test tubes, instruments of precision, dissecting instruments and microscopes. What influence premature experimentation may have on the advanced study of chemistry and physics, I cannot say, but in biology it results in a generation of young persons whose only ideas of beauty, variety, and life-conditions of the living world are derived from the dissection of five or six plants and animals. I would greatly prefer to have a student come to me for advanced work in zoölogy, knowing something about the habits and life-histories, the external morphology and classification of a large number of animals than to have one who knew only the digestive, circulatory, excretory, and nervous systems of five or six forms. And this order of presentation would be the best for the student whether he ever pursued advanced subjects in biology or not. In all cases natural history should precede anatomy, histology, or embryology, and I think it might well precede any other science. Physiology as commonly taught in the schools, *i. e.*, without laboratory work, might much better be replaced by natural history, which, when properly taught, would contain all that part of physiology which could be brought under direct observation without the aid of special apparatus.

This tendency on the part of preparatory schools to take up the more advanced subjects of any science and omit the more elementary ones leads me to the consideration of Professor Wilson's theses Nos. 4, 5, and 6. There seems to be a perfect craze for specialization in these times. There was a time when some persons looked with misgivings upon the tendency to specialize in the college, and I think that even now most educators would agree that it is not wise to begin to specialize as early as the freshman year, and certainly not before that time. Under existing circumstances I believe that the high schools

and preparatory schools would better fulfill their functions to those who go to college and to those who do not, if they were to devote a year to each of several sciences rather than several years to any one science. Even two years of any one science would necessitate the crowding out of some other important one, and this I feel ought not to be done. The physical sciences are so interdependent that one cannot properly understand one without some knowledge of the others, and it seems to me that physics, chemistry, biology, and perhaps also the earth sciences, as Professor Tarr¹ has suggested, should each be given one year in every well equipped preparatory school. I acknowledge the cultural value of *intensive* work, but in the preparatory schools we must have *extension*:—if not here, where will it be had? If young men and women are to be prepared not only for college, but also to take an intelligent interest in the world in which they live, it is necessary that they have the broader rather than the narrower training; and if the devoting of two years to chemistry, or physics, or biology, involves, as it does, the dropping of some other subject, it seems to me that it would be a very unfortunate thing to do. As teachers, I suspect that we are all guilty of exalting our subject and forgetting other subjects, of striving to meet the needs of an ideal curriculum rather than those of the actual student. We forget that the things which are of most value to us may not be most valuable to our pupils. It frequently happens that teachers, fresh from the universities, attempt to import university method into preparatory schools, to open university courses, journal clubs, seminars and research work for elementary students, while at the same time the fundamentally important elementary work is neglected. So far as the subject of biology is concerned, I believe that this is largely due to the fact that teachers have had no adequate training in the more elementary subjects, such as natural history; they come up to the colleges and universities without any such training and they do not get it in these higher institutions of learning. It has sometimes seemed to me that the only remedy for this state of affairs is for the universities to exchange places with the preparatory schools; certainly the higher institutions must take up this elementary work if they are to fit teachers for the preparatory schools. If there is time for specialization in the preparatory schools after these necessary foundations have been laid I for one should not object, but I do object to any system which builds from the top down.

¹ Professor Tarr's paper was published in the *Journal of Pedagogy*, January 1898.